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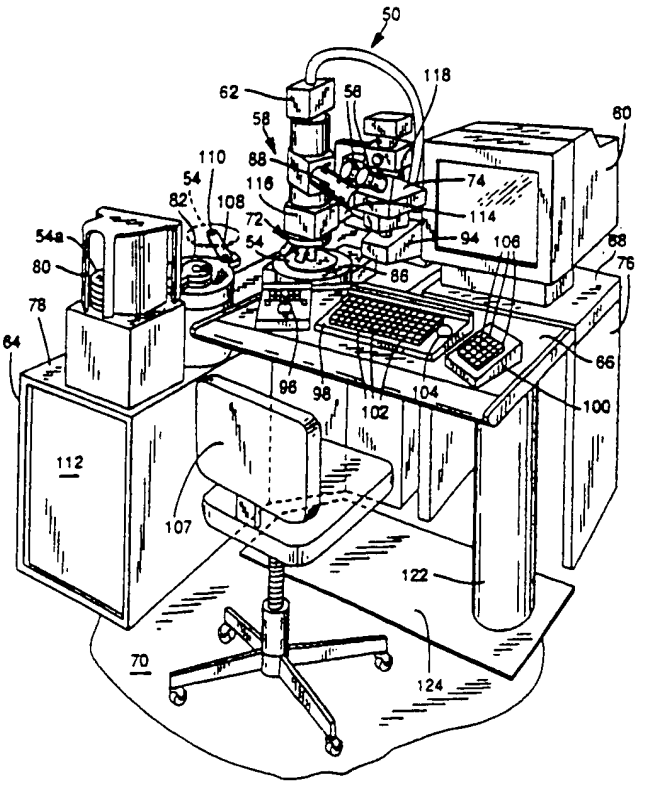
(54) Title: SPECIMEN REVIEW STATION

(57) Abstract

A specimen review station (50) includes a vibration isolation table (64) that supports storage (80) and transportation (82, 84) equipments for a semiconductor wafer (54) and an optical system (58) for viewing microscopic regions of the patterned surface of the wafer. The optical system (58) includes an image extender (88) that enables an operator sitting on an adjustable chair (107) to view the wafer from a distance, thereby facilitating remote transportation and inspection of relatively large diameter wafers and reducing operator contamination of the wafer. An operator table (66) supports control equipments (96, 98, 100), which the operator uses to control the functions of the specimen review station. The vibration isolation table and the operator table are spatially isolated from each other in that they are connected only by the floor (70) that supports both of them. The vibration isolation table is, therefore, affected by neither floor vibrations resulting from normal building movement associated with manufacturing operations nor operator contact with the operator table.



SPECIMEN REVIEW STATION

Technical Field

The present invention relates to specimen review stations and, in particular, to a specimen review station that a human operator uses to review selected regions of a specimen such as a semiconductor wafer or a liquid crystal display panel.

Background of the Invention

A semiconductor wafer includes an array of circuit dies or "chips" of which each has an electrical circuit pattern that is frequently called an integrated circuit ("IC"). Each chip is packaged with electrical leads so that the chip can be incorporated into an electronic device.

Wafer defects can prevent the chip from performing correctly. An article by Pieter Burggraat, "Auto Wafer Inspection: Tools for Your Process Problems," Semiconductor International, December 1988, lists defect-causing problems that can arise during the wafer fabrication process. These include problems caused by wafer contamination, foreign microscopic particles, residual chemicals, reaction by-products, incomplete etch, residual photoresist, closed contacts, and micro-cracks. The need for detecting sub-micron defects has increased recently as a consequence of the production of ICs with features having sub-micron dimensions.

Currently available sophisticated automated

wafer inspection systems rapidly and accurately locate wafer defects, which are then analyzed and characterized by a human operator. Currently practiced wafer defect inspection entails an automated phase and a review phase. During the automated phase, an automated wafer inspection system locates defects on the wafer. During the review phase, the operator uses high resolution optics included as part of a specimen review station to observe, characterize, and classify defects previously located by the automated wafer inspection system.

Fig. 1 is a diagram of Nikon Optistation™, which is sold by Nikon Inc., Instrument Group, Garden City, New York, and is representative of currently available wafer inspection systems. Referring to Fig. 1, the wafer inspection system 10 includes a high resolution optical system 12 in which an objective 14 is mounted and positioned directly overhead a motor-driven stage 16 that supports a semiconductor wafer 18. Stage 16 imparts translational motion to wafer 18 beneath objective 14 in accordance with an operator-programmable inspection sequence.

An operator (not shown) seated near the front side of a housing 20 for stage 16 inspects wafer 18 for defects by looking through a pair of eyepieces 22 of optical system 12. To carry out the inspection, the operator performs several functions. For example, the operator manipulates a joystick 26 to manually control the position of stage 16. The operator also uses a keyboard 28 to enter instructions to automatically control the position of stage 16 or to classify a defect. Joystick 26 and keyboard 28 are positioned on either side of stage housing 20. The operator views alpha-numeric information on a display unit 30 positioned behind stage 16.

A significant limitation of inspection system 10 is that its configuration restricts the size of wafer 18,

which is moved under objective 14 of optical system 12. A wafer 18 of relatively large diameter is positioned on stage 16 so that whenever the rear portion of wafer 18 is under objective 16, the front portion of wafer 18 would protrude into the operator's work area and strike the operator. The operator would either be forced to hunch over wafer 18 to look into eyepieces 22 or be unable to inspect the entire wafer surface. Such an intolerable situation would exist with the use of currently available inspection systems, such as the Nikon Optistation™, which inspect wafers with a maximum diameter of 6 inches. Wafers are now being produced with 8 inch diameters, and wafers with 12 inch diameters are expected to be available soon.

Another limitation stemming from the configuration of inspection system 10 is that it is difficult to use a high-speed stage 16 to increase throughput. This is so because high-speed X-Y translation stages are typically taller than their low speed counterparts. The use of a relatively tall stage 16 would increase the required distance between the operator's lap and eyes and thereby allow little or no space for the operator's knees beneath table 32 when the operator positions oneself at a comfortable eye level to look through eyepieces 22.

A problem inherent in inspection system 10 is that the normal use thereof enhances the likelihood that human contamination will result in the introduction of defects in wafer 18 during in-process inspection. The susceptibility to human contamination stems from the positioning of wafer 18 almost directly beneath the eyepieces 22, thereby maximizing the possibility of human contamination from the operator. To prevent this problem, certain conventional inspection systems have an encapsulated area located beneath the high resolution

optics, but this solution to human contamination requires clean air hookups to transmit clean air through the enclosed work area.

A second problem is that sub-micron precision and accuracy is affected by vibrations from the building environment or the operator's movements. The occurrence of a minor vibration during the inspection of sub-micron defects can create serious alignment and distortion problems. This vibration problem is further exacerbated in inspection system 10 because stage 14 and the operator equipment, such as joystick 26 and keyboard 28, are supported by a single table 32.

A third problem, which is also caused by positioning wafer 18 directly beneath eyepieces 22, is that there is very little space remaining for the operator equipment. One conventional inspection system has solved this problem in part by increasing the horizontal distance between the operator and the wafer by means of elongated eyepieces. However, despite the increased length of the eyepieces, the wafer and operator equipment are still supported by the same table.

There is, therefore, a need for a specimen review station that is insensitive to normal building floor vibration, as well as movement by and contamination from the operator.

Summary of the Invention

An object of the present invention is, therefore, to provide a specimen review station that facilitates the examination of relatively large diameter specimens.

Another object of the invention is to reduce the effects of floor vibration on the inspection of a specimen in a specimen review station.

A further object of the invention is to reduce contamination of a specimen undergoing inspection in a

specimen review station.

Still another object of the invention is to provide a vibration-isolated and contamination-free specimen review station that is convenient for use by an operator and occupies minimal floor space.

Yet another object of the invention is to provide a specimen review station that has good ergonomic qualities and is capable of high throughput operation.

The present invention is a specimen review station that includes a vibration isolation table supporting storage and transportation equipment for a specimen and an optical system for viewing microscopic regions of the surface of the specimen. The following description is given only by way of example with reference to the inspection or review of a semiconductor wafer for defects therein. The optical system includes an image extender that enables an operator to view the wafer from a distance through a microscope, thereby facilitating remote transportation and inspection of relatively large diameter wafers and reducing the amount of operator contamination of the wafer.

An operator table supports control equipment that the operator uses to control the functions of the specimen review station. The vibration isolation table and the operator table are spatially isolated from each other in that they are connected only by the floor that supports both of them. The vibration isolation table is, therefore, affected by neither floor vibrations resulting from normal building movement nor operator contact with the operator table. Protective skins enclose the wafer transportation equipment and optical system, except for the microscope eyepieces, to enhance operator and bystander safety.

Additional objects and advantages of the present invention will be apparent from the detailed description

of a preferred embodiment thereof, which proceeds with reference to the accompanying drawings.

Brief Description of the Drawings

Fig. 1 is a frontal view of a conventional prior art wafer inspection system.

Fig. 2 is a fragmentary perspective view looking from the rear of a specimen review station of the present invention, with the protective enclosure skins removed.

Fig. 3 is a plan view of the specimen review station of Fig 2, with the protective enclosure skins removed.

Fig. 4 is a perspective view looking from the front of the specimen review station of the present invention, with the protective enclosure skins removed.

Fig. 5 shows the view of the specimen review station of Fig. 4, with the protective enclosure skins in place.

Detailed Description of Preferred Embodiment

Figs. 2, 3, and 4 show different views of a specimen review station 50 of the present invention. Referring to Fig. 2 in particular, specimen review station 50 enables an operator 52 (shown wearing a clean room "bunny suit") to view selectable microscopic regions of the patterned surface of a semiconductor wafer 54. The microscopic regions may be viewed directly through a pair of microscope eyepieces 56 of an optical system 58 or by television-type images presented on a cathode-ray tube (CRT) monitor 60. The images are generated from a video signal provided by a CCD camera 62 that senses light coming from the region that operator 52 views through eyepieces 56. CRT monitor 60 also displays data derived from a previously generated defect map containing information about the locations and characteristics of defects in the patterned wafer. The defect map is typically generated by an automated wafer inspection

system (not shown), such as a Model 8600 Holographic Wafer Inspection System manufactured by Insystems, Inc., San Jose, California, which is the assignee of the present application. CRT monitor 60 has a split screen capability that selectively provides for either a simultaneous display of video image and data graphics information or an expanded video image over the entire monitor screen.

Specimen review station 50 includes a vibration isolation table 64, an operator table 66, and a CRT table 68. Vibration isolation table 64 and operator table 66 are spatially separate, i.e., connected only by floor 70, to provide vibration isolation from table 66 to table 64. Vibration isolation table 64 supports the mechanisms for transporting and repositioning wafer 54 beneath an objective 72 of optical system 58 during a review process. Vibration isolation table 64 also supports optical system 58, including the eyepieces 56 which extend over operator table 66 and through which operator 52 looks. Optical system 58 allows operator 52 to directly view a selected region of the patterned surface of the remotely located wafer 54. CRT table 68 is placed so that CRT monitor 60 is in the direct view of operator 52 whenever he or she looks away from eyepieces 56. CRT table 68 houses an electronics rack 76 (Fig. 4), which holds the various electronic equipment needed for the operation of review station 50.

Vibration isolation table 64 has an upper surface 78 on which a wafer cassette 80, an automated wafer handler 82, and an X-Y stage 84 are placed. (X-Y stage 84 is preferably capable of linear motion along a Z-axis, which is perpendicular to the plane of X-Y motion, to facilitate an autofocus function and of rotational motion about the Z-axis to facilitate wafer alignment.) Wafer handler 82 transports wafer 54 between cassette 80, which stores wafer 54, and X-Y stage 84, on which wafer 54

is secured during inspection.

Wafer 54 is placed on a vacuum chuck 86 located on the top surface of X-Y stage 84 beneath objective 72 of optical system 58. As was indicated above, optical system 58 extends from X-Y stage 84 to operator table 66. Optical system 58 includes objective 72 and eyepieces 56 that are separated from each other by an illuminator dual-port image extender 88. Objective 72 is positioned above X-Y stage 84 by an objective support 90, which is secured to a member 92 extending upwardly from and attached to the rear of vibration isolation table 64. Eyepieces 56 are mounted above operator table 66 to an L-shaped bracket 94, one leg of which extends upwardly from and is secured to the surface near the front of vibration isolation table 64.

Optical system 58, eyepiece support bracket 94, and objective support 90 are not attached to operator table 66. Optical system 58 and vibration isolation table 64 are, therefore, not affected by vibration that results from movement of operator table 66.

Objective 72 and eyepieces 56 are separated from each other by an image extender 88 of sufficient length that allows operator 52 to sit comfortably at operator table 66 without coming into contact with vibration isolation table 64. In a preferred embodiment, extender 88 is straight and is approximately 27 inches in length. It will be appreciated that extender 88 may be a combination of vertical and horizontal sections connected together to form a light passageway. Eyepiece support bracket 94 is sufficiently massive so that it does not cause vibrational movement of vibration isolation table 64 in response to the building environment or operator 52 contacting eyepieces 56 to inspect wafer 54.

Referring to Figs. 2 and 3, typical equipment used by operator 52 and situated on operator table 66

include a joystick 96, keyboard 98, and classification pad 100. Joystick 96 controls the position of chuck 86 on X-Y stage 84. By changing the position of chuck 86, operator 52 can view any portion of the surface of wafer 54. In a preferred embodiment, objective 72 remains stationary while chuck 86 is moved.

Keyboard 98 includes alpha-numeric keys 102 and a trackball 104. Trackball 104 controls the position of a cursor displayed with menus on CRT monitor 60. Classification pad 100 includes multiple keys 106 that operator 52 strikes to indicate different types of wafer defects.

The separation of operator table 66 from vibration isolation table 64 allows operator 52 to move operator table 66 in horizontal and vertical directions to desired positions without affecting optical system 58 or wafer 54. A chair 107 on which operator 52 sits can be adjusted horizontally and vertically without interfering with vibration isolation table 64. Operator 52 can reposition joystick 96, keyboard 98, and classification pad 100 on the surface of operator table 66 without affecting optical system 58 or wafer 54. The ability to move operator table 66, the chair, joystick 96, keyboard 98, and classification pad 100 increases operator comfort and reduces fatigue, and thereby increases operator efficiency.

One advantage of the above-described remote viewing capability is that operator 52 can sit sufficiently far from vibration isolation table 64 to stretch his or her legs and otherwise move about without causing vibration-induced movement of the wafer 54 positioned on vibration isolation table 64. Another advantage is that operator table 66 can be sufficiently large to conveniently hold equipment and to allow operator 52 to adjust the position of the equipment.

An inspection or review of wafer 54 is carried out as follows. Wafer 54 is placed on chuck 86 by automated wafer handler 82. Wafer handler 82 includes a paddle 108. Wafer 54 is held at various times onto paddle 108 by an external vacuum source (not shown) that draws air through vacuum hole 110. (Wafer 54 is shown in phantom on paddle 108 in Figs. 2-4.) A light source (not shown) housed in an equipment cabinet 112 located below top surface 78 of vibration isolation table 64 delivers through an optical fiber bundle (not shown) to a vertical illuminator 114 a sufficient quantity of light to illuminate wafer 54. The light source, together with the review station power supply equipment, is housed away from vertical illuminator 114 to keep heat and air turbulence away from wafer 54. Light reflected and diffracted by wafer 54 and received by objective 72 propagates to a trinoc 116 in optical system 58. The light is split by a partly reflecting cube or mirror positioned inside trinoc 116. The light transmitted by the reflecting cube or mirror is received by CCD camera 62, and the light reflected by the reflecting cube or mirror travels through image extender 88 to eyepieces 56. The image delivered to eyepieces 56 may be photographed by a camera 118. CCD camera 62 provides video information corresponding to the region of wafer 54 positioned beneath objective 72. The video information is delivered to CRT monitor 60 for display as a video image to operator 52.

Operator 52 uses keyboard 98 to display on CRT monitor 60 menu items that enable the positioning of a desired region of wafer 54 beneath objective 72. Operator 52 uses trackball 104 to position a cursor on the screen of CRT monitor 60 to select a desired menu item. The region of wafer 54 positioned beneath objective 72 also appears on the screen of CRT monitor 60. Operator 52 has the ability, therefore, to view the region of wafer 54

through eyepieces 56 or an image of the region on CRT monitor 60. Joystick control 96 allows the operator to change the position of chuck 86 on X-Y stage 84 and thereby change the region within the field of view of objective 72. During the inspection of wafer 54, operator 52 uses classification pad 100 to encode information indicative of the character of a defect appearing in a specific location on wafer 54.

After wafer 54 has been inspected, wafer handler 82 moves paddle 108 within an open space between wafer 54 and chuck 86 so that vacuum hole 110 is positioned underneath wafer 54. Wafer 54 is then elevated, and paddle 108 is rotated so that wafer 54 is returned to the appropriate slot in wafer cassette 80. Wafer handler 82 then moves paddle 108 underneath a wafer 54a located in a different slot in cassette 80, and takes up and transports wafer 54a for delivery to X-Y stage 84, as described above.

Referring to Fig. 3, the plan view of specimen review station 50 shows that vibration isolation table 64, operator table 66, and CRT monitor table 68 are separate from the others, being joined only by common floor 70. Vibration isolation table 64 reduces the effects of floor vibration on a wafer 54 positioned on X-Y stage 84. The distance between the tables also is sufficiently large so that the operator 52 will not bump operator table 66 into vibration isolation table 64 during the normal course of operation.

Referring to Fig. 4, the frontal view of specimen review station 50 shows that the surface of operator table 66 is positioned higher than that of vibration isolation table 64 and does not touch vibration isolation table 64. Operator table 66, which is vertically adjustable, is preferably mounted to a base plate 124 by a single extensible post 122 that is placed

on the opposite end of operator table 66 from vibration isolation table 64.

The length of image extender 88 allows wafer 54 to be located a sufficient distance from operator 52 such that the amount of operator contaminants reaching wafer 54 is minimized. Specimen review station 50 has minimal obstructions in the path of air currents that flow through the clean room environment in which review station 50 would typically be located. Therefore, the arrangement of review station 50 promotes a downwardly directed air current to flow freely off of wafer 54 and thereby decreases the number of contaminants that may contact the wafer.

Chuck 86 and wafer handler 82 are positioned such that specimen review station 50 can transport and position for examination a wafer 54 having a relatively large diameter, e.g., 8 inches. In the preferred embodiment, there are no components of specimen review station 50 that would interfere with the movement and examination of a wafer having an 8.0 inch diameter. In the specification and claims, the term "specimen" is not limited to a circular object and the term "diameter" is not limited to describing the diameter of a circular object.

The shape of vibration isolation table 64 and arrangement of the optical components allow specimen review station 50 to have a small footprint. Typical dimensions would be approximately 4 feet by 5 feet. Vibration isolation table 64 has a covering placed over it to minimize the chance of operator 52 or another person accidentally interfering with the operation of specimen review station 50. Vibration isolation table 64 may optionally be placed in a separate room from which operator table 66 and CRT table 60 could be located.

Automated wafer handler 82 and X-Y stage 84 are

of the types that may be purchased from Kensington Laboratories in Richmond, California. Vibration isolation table 64 is of the type that may be purchased from Newport Corp. of Fountain Valley, California.

The optical components of the preferred embodiment of the present invention can be purchased from optical parts suppliers. The following exemplary parts list includes parts available from Scientific Instrument Company, 1128 W. Evelyn Ave., Sunnyvale, California, 94086.

Part	Reference Number	Description	Order No.
Objective	72	20X NEO S PLAN 0.40NA DIC	1-LM444
		50X NEO S PLAN 0.70 NA DIC	1-LM454
		100X NEO S PLAN 0.90 NA DIC	1-LM494
		150X NEO DPLAN 0.85	1-LM492
Eyepiece	56	EYEPIECE WHK10X	2-LC321
		EYEPIECE WHK10X FOC	2-LC232
Dual Port Image Extender	88	SPECIAL LONG DUAL PORT EXTENDER	21-031-01
Trinoc	116	TRINOC TUBE TILTING ERECT	3-LC407
		B/F CUBE, UMA	M-L0897
		D/F CUBE, UMA	M-L0898
CCD Camera	62	SIERRA SCIENTIFIC HIGH RESOLUTION CCD CAMERA	

The specimen review station of this invention is not limited to inspecting semiconductor wafers. It is

also useful for inspecting other objects with microscopic components or patterns, such as, for example, compact disks and liquid crystal display panels.

Fig. 5 shows specimen review station 50 with protective enclosure skins 126 supported by vibration isolation table 64. Referring to Fig. 5, protective skins 126 cover most of upper surface 78 of and the equipment resting on vibration isolation table 64, and most of optical system 58. Openings 128 and 130 provide direct operator access to wafer cassette 80 and to eyepieces 56, respectively. A cutout 132 of parallelopiped shape in side 134 of protective skins 126 permits the operator to view wafer handler 82 (Fig. 4) during wafer inspection.

It will be obvious to those having skill in the art that many changes may be made in the above-described details of the preferred embodiment of the present invention without departing from the underlying principles thereof. For example, the inspection system can be readily adapted to inspect transmissive specimens. The scope of the present invention should, therefore, be determined only by the following claims.

Claims

1. A review station for enabling an operator to inspect a selected microscopic region of a specimen, comprising:

vibration isolation means for supporting and providing vibration isolation for the specimen;

optical means for enabling the operator to inspect the selected microscopic region of the specimen, the optical means being supported by the vibration isolation means;

operator control equipment means for use by the operator to control at least one function performed by the specimen review station during inspection of the specimen; and

operator control equipment support means for supporting the operator control equipment means, the operator control equipment support means being spatially isolated from the vibration isolation means.

2. The review station of claim 1, wherein the specimen is a semiconductor wafer.

3. The review station of claim 1, wherein the specimen is of the patterned type.

4. The review station of claim 1, further comprising a monitor and monitor support means for supporting the monitor, the monitor support means being spatially isolated from the operator control support means and the vibration isolation means.

5. The review station of claim 1 wherein a common floor in a building supports the vibration isolation means and the operator control equipment support means, and wherein the vibration isolation means is vibration isolated in that it is not affected by floor vibrations resulting from normal building movement or operator contact with the operator control equipment means or the operator control equipment support means.

6. The review station of claim 1 wherein the operator control equipment means and the vibration isolation means are separated by a distance that spatially isolates the operator control equipment means from the vibration isolation means during normal contact among the operator, the operator control equipment support means, and the operator control equipment means.

7. The review station of claim 1, wherein the vibration isolation means is contained in a separate operating environment from that of the operator control equipment support means.

8. A review station for enabling an operator to inspect a selected microscopic region of a specimen, comprising:

means for directing light to illuminate the specimen;

objective means for receiving light propagating from the specimen;

optical eyepiece means receiving the light from the objective means for enabling the operator to inspect the selected microscopic region; and

optical extension means for providing an enclosed path through which the light propagates from the objective means to the optical eyepiece means, the optical extension means being of sufficient length so that the eyepiece means is remote from the objective means.

9. The review station of claim 8, further comprising vibration isolation means for supporting and providing vibration isolation for the specimen, and wherein the optical extension means is of sufficient length to enable the operator to inspect the specimen from a remote location.

10. The review station of claim 8, further comprising vibration isolation means for supporting and providing vibration isolation for the specimen, and

wherein the optical extension means is of sufficient length to enable the operator positioned adjacent the eyepiece means to operate the review station and not produce vibrations that would affect the specimen supported by the vibration isolation means.

11. The review station of claim 8, wherein the specimen is a semiconductor wafer.

12. The review station of claim 8, further comprising:

a clean room environment in which the specimen is supported, wherein the specimen is exposed to clean air such that clean air currents flow over the specimen and remove contamination from the specimen without significant obstruction from components of the review station.

13. A review station for enabling an operator to inspect a selected microscopic region of a specimen, comprising:

vibration isolation means for supporting and providing vibration isolation for the specimen;

operator control equipment support means for providing an operator work area from which the operator inspects the specimen, the operator control equipment support means being spatially isolated from the vibration isolation means; and

optical means for enabling the operator to inspect the selected microscopic region of the specimen, the optical means being spatially isolated from the operator control equipment support means.

14. A review station for enabling an operator to manipulate a specimen and view a selected microscopic region of a specimen, comprising:

operator control equipment means for controlling at least one review station function involved in the manipulation or viewing of the specimen;

operator control equipment support means for

supporting the operator control equipment means;

means for directing light to illuminate the specimen;

objective means for receiving light propagating from the specimen;

optical eyepiece means for receiving the light from the objective means and enabling the operator to view the selected microscopic region;

vibration isolation means for supporting and providing vibration isolation for the specimen; and

optical extension means for providing an enclosed path through which the light propagates from the objective means to the optical eyepiece means, the optical extension means being of sufficient length to enable the operator to manipulate the specimen and view the microscopic region of the specimen and control the operator control equipment means in a fashion consistent with the manipulation of the specimen and viewing the microscopic regions of the specimen without coming into contact with the vibration isolation means.

15. A review station of claim 14 wherein the optical extension means is of sufficient length to prevent the specimen from contacting the operator when the operator is inspecting the specimen.

16. The review station of claim 14 wherein the means for directing light further comprises:

a light source located remote from the specimen so that heat and air turbulence from the light source do not affect the viewing of the microscopic region of the specimen;

a vertical illuminator positioned proximate the specimen for providing light to illuminate the specimen; and

fiber optic bundle means for transporting the light from the light source to the vertical illuminator.

17. The review station of claim 1, further comprising:

display means for showing information relating to the specimen or video images of the specimen; and

display support means for supporting the viewing means, the display support means being spatially isolated form the vibration isolation means.

18. The specimen review station of claim 17, further comprising:

storage means for holding various electronics equipment, the storage means housed in the video support means.

19. The specimen review station of claim 1, wherein:

the operator control equipment support means is a desk or a table; and

the operator control equipment means is a keyboard joystick, trackball, or classification pad.

20. The specimen review station of claim 13, further comprising:

an adjustable chair upon which the operator can sit, the chair capable of being located partly beneath the operator work area as the operator inspects the specimen.

AMENDED CLAIMS

[received by the International Bureau on 13 March 1991 (13.03.91);
original claims 1,3,4,8,9,12-14 and 17-19 amended;
new claims 21 and 22 added; other claims unchanged
(6 pages)]

1. A review station for enabling an operator to inspect a selected microscopic region of a specimen, comprising:

vibration isolation means for supporting and providing vibration isolation for the specimen;

optical means for enabling the operator to inspect the selected microscopic region of the specimen, the optical means being supported by the vibration isolation means;

operator control equipment means for use by the operator to control the review station during inspection of the specimen; and

operator control equipment support means for supporting the operator control equipment means, the operator control equipment support means being spatially isolated from the vibration isolation means.

2. The review station of claim 1, wherein the specimen is a semiconductor wafer.

3. The review station of claim 1, wherein the specimen is of a patterned type.

4. The review station of claim 1, further comprising a monitor and monitor support means for supporting the monitor, the monitor support means being spatially isolated from the operator control equipment support means and the vibration isolation means.

5. The review station of claim 1 wherein a common floor in a building supports the vibration isolation means and the operator control equipment support means, and wherein the vibration isolation means is vibration isolated in that it is not affected by floor vibrations resulting from normal building movement or operator contact with the operator control equipment means or the operator control equipment support means.

6. The review station of claim 1 wherein the

operator control equipment means and the vibration isolation means are separated by a distance that spatially isolates the operator control equipment means from the vibration isolation means during normal contact among the operator, the operator control equipment support means, and the operator control equipment means.

7. The review station of claim 1, wherein the vibration isolation means is contained in a separate operating environment from that of the operator control equipment support means.

8. A review station for enabling an operator to inspect a selected microscopic region of a specimen, comprising:

means for directing light to illuminate the specimen;

objective means for receiving light propagating from the specimen;

optical eyepiece means receiving the light from the objective means for enabling the operator to inspect the selected microscopic region; and

optical extension means for providing an enclosed path through which the light propagates from the objective means to the optical eyepiece means, the optical extension means being of sufficient length so that the eyepiece means is remote from the objective means and the operator can inspect the microscopic region of the specimen while minimizing contamination of and vibrations to the specimen.

9. The review station of claim 8, further comprising vibration isolation means for supporting and providing vibration isolation for the specimen;

operation control equipment means for use by the operator to control the review station during inspection of the specimen; and

operator control equipment support means

spatially isolated from the vibration isolation means for supporting the operator control equipment means.

10. The review station of claim 8, further comprising vibration isolation means for supporting and providing vibration isolation for the specimen, and wherein the optical extension means is of sufficient length to enable the operator positioned adjacent the eyepiece means to operate the review station and not produce vibrations that would affect the specimen supported by the vibration isolation means.

11. The review station of claim 8, wherein the specimen is a semiconductor wafer.

12. The review station of claim 8, further comprising:

a clean room environment in which the specimen is supported, wherein the specimen is exposed to clean air such that clean air currents flow over the specimen and remove contamination from the specimen without significant obstruction from the review station.

13. A review station for enabling an operator to inspect a selected microscopic region of a specimen, comprising:

vibration isolation means for supporting and providing vibration isolation for the specimen;

review station control equipment that is used by the operator to control the review station;

review station control equipment support means for supporting the review station control equipment and for providing an operator work area from which the operator inspects the specimen, the operator control equipment support means being spatially isolated from the vibration isolation means; and

optical means for enabling the operator to inspect the selected microscopic region of the specimen, the optical means being spatially isolated from the

operator control equipment support means.

14. A review station for enabling an operator to inspect a selected microscopic region of a specimen, comprising:

review station control equipment that is used by the operator in controlling the review station;

review station control equipment support means for supporting the review station control equipment;

means for directing light to illuminate the specimen;

objective means for receiving light propagating from the specimen;

optical eyepiece means for receiving the light from the objective means and enabling the operator to view the selected microscopic region;

vibration isolation means for supporting and providing vibration isolation for the specimen; and

optical extension means for providing an enclosed path through which the light propagates from the objective means to the optical eyepiece means, the optical extension means being of sufficient length to enable the operator to operate the review station control equipment and view the microscopic region of the specimen in a normal manner without coming into contact with the vibration isolation means.

15. A review station of claim 14 wherein the optical extension means is of sufficient length to prevent the specimen from contacting the operator when the operator is inspecting the specimen.

16. The review station of claim 14 wherein the means for directing light further comprises:

a light source located remote from the specimen so that heat and air turbulence from the light source do not affect the viewing of the microscopic region of the specimen;

a vertical illuminator positioned proximate the specimen for providing light to illuminate the specimen; and

fiber optic bundle means for transporting the light from the light source to the vertical illuminator.

17. The review station of claim 1, further comprising:

display means for showing information relating to the specimen and video images of the specimen; and

display support means for supporting the display means, the display support means being spatially isolated from the vibration isolation means.

18. The specimen review station of claim 17, further comprising:

storage means for holding various electronics equipment, the storage means housed in the display support means.

19. The specimen review station of claim 1, wherein:

the operator control equipment support means is a table; and

the operator control equipment means is a keyboard, joystick, trackball, or classification pad.

20. The specimen review station of claim 13, further comprising:

an adjustable chair upon which the operator can sit, the chair capable of being located partly beneath the operator work area as the operator inspects the specimen.

21. A review station for enabling an operator to inspect a selected microscopic region of a specimen, comprising:

vibration isolation means for supporting and providing vibration isolation for the specimen;

optical means supported by the vibration isolation means for enabling the operator to inspect the

selected microscopic region of the specimen;

operator control equipment means for use by the operator to control functions of the review station during inspection of the specimen; and

operator control equipment support means for supporting the operator control equipment means, the operator control equipment support means being spatially isolated from the vibration isolation means.

22. A method for reducing contamination and vibrations to a specimen in a review station for enabling an operator to inspect a selected microscopic region of a specimen, comprising the steps of:

directing light to illuminate the specimen;

collecting with an objective light propagating from the specimen;

providing to an eyepiece assembly the light collected by the objective so that the operator may use the eyepiece assembly to inspect the selected microscopic region; and

providing an optical extension tube to deliver through an enclosed path the light from the objective to the eyepiece assembly, the optical extension tube being of sufficient length so that the eyepiece assembly is remote from the objective and the operator can inspect the microscopic region of the specimen while minimizing contamination of and vibrations to the specimen.

FIG. 1
(Prior Art)

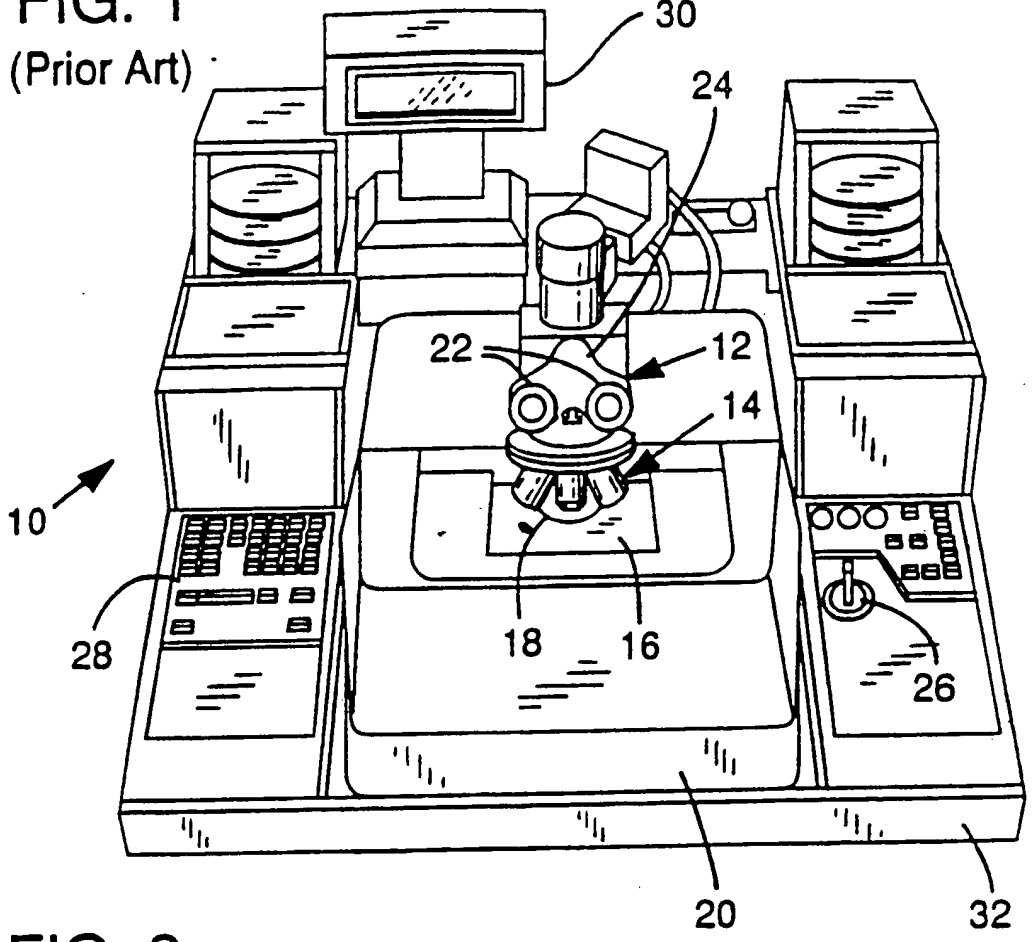


FIG. 3

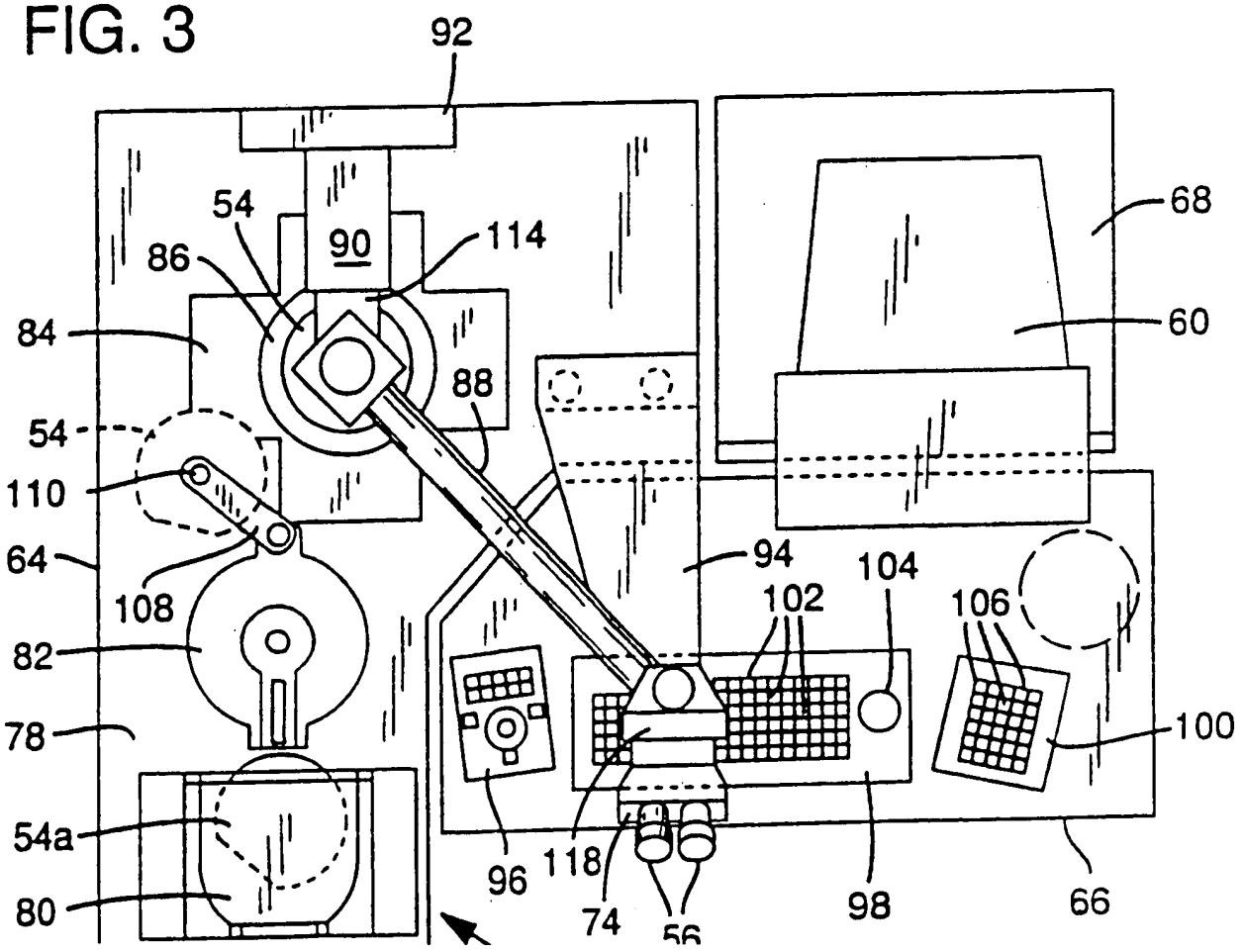


FIG. 2

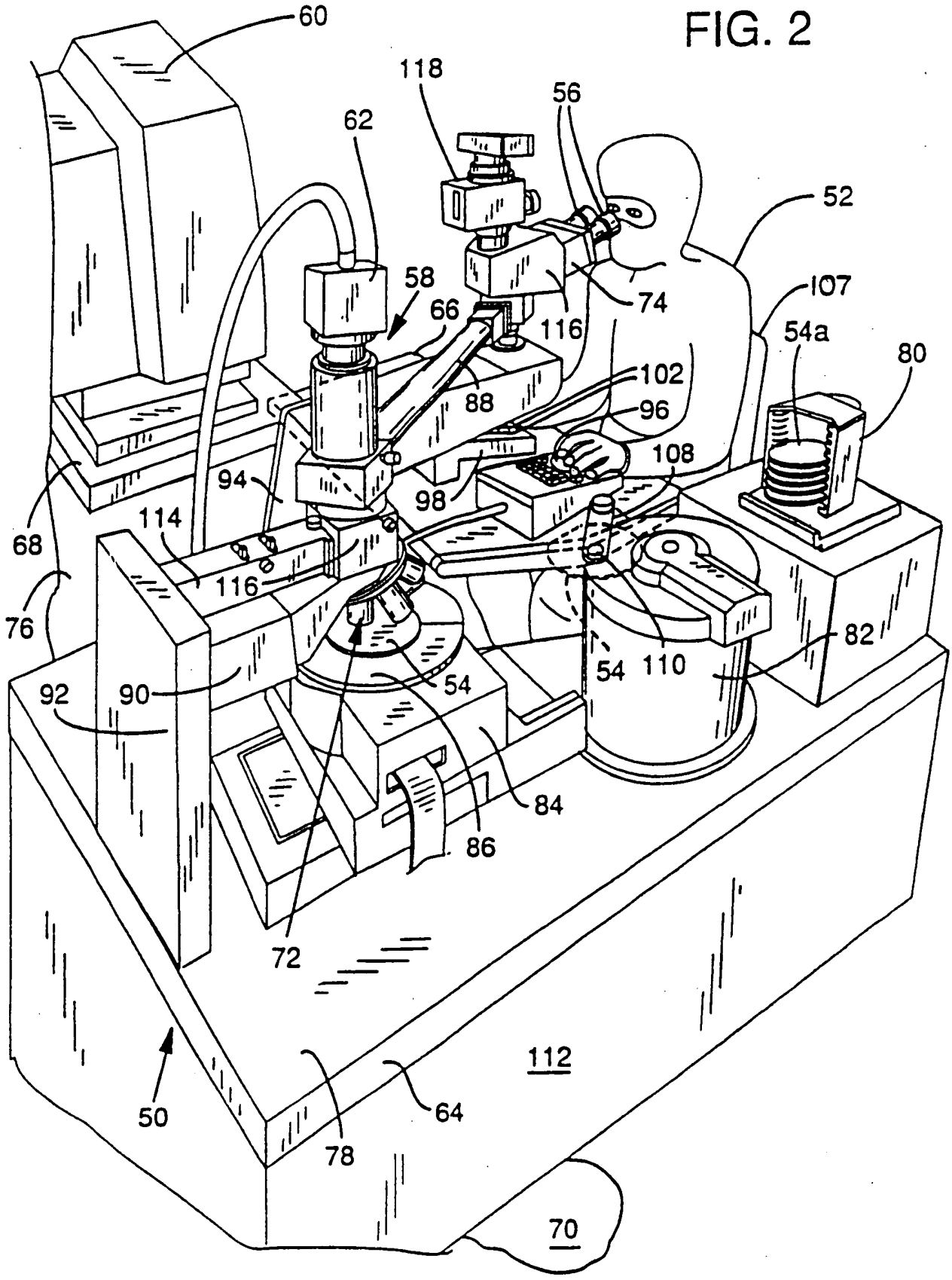

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FIG. 4

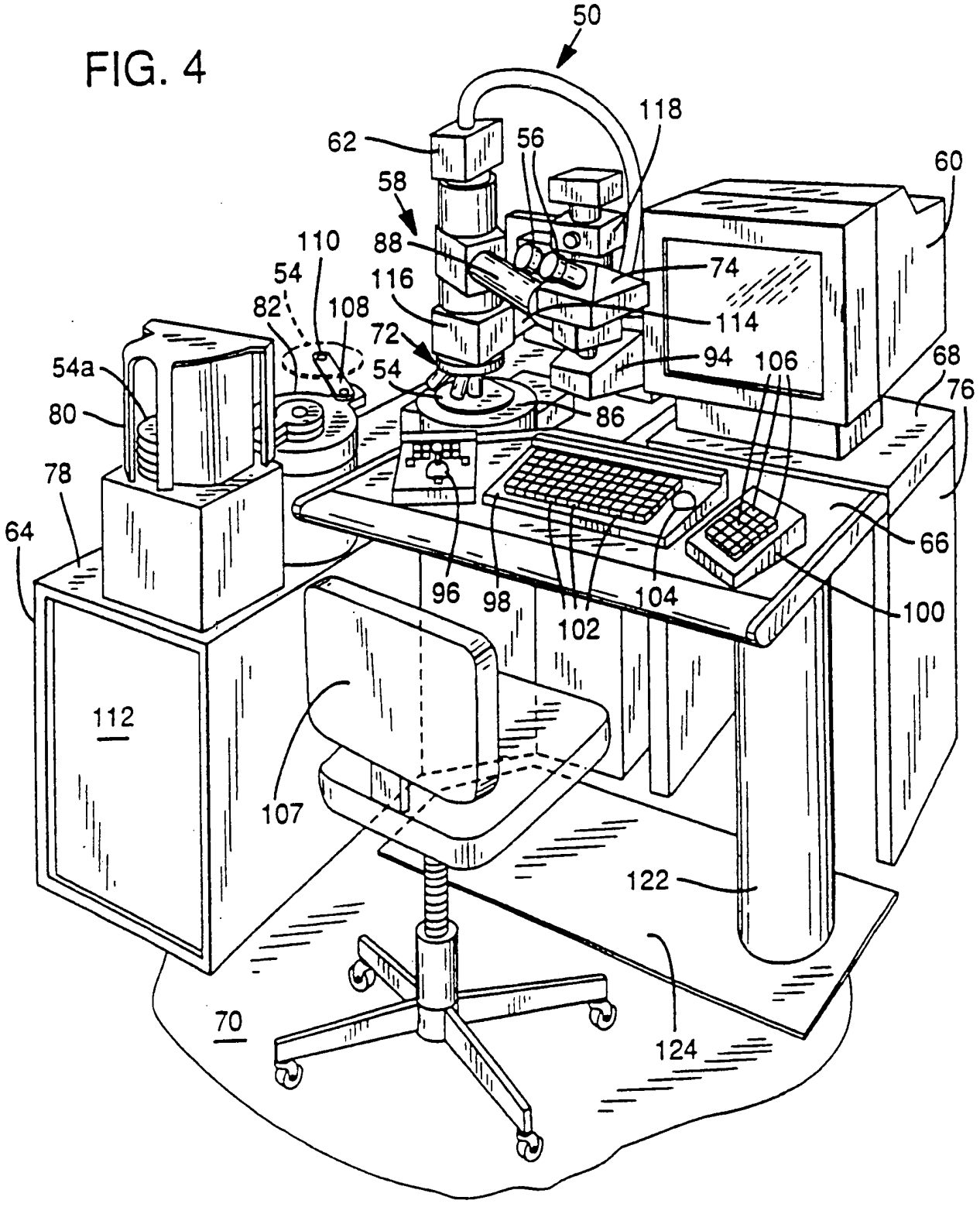
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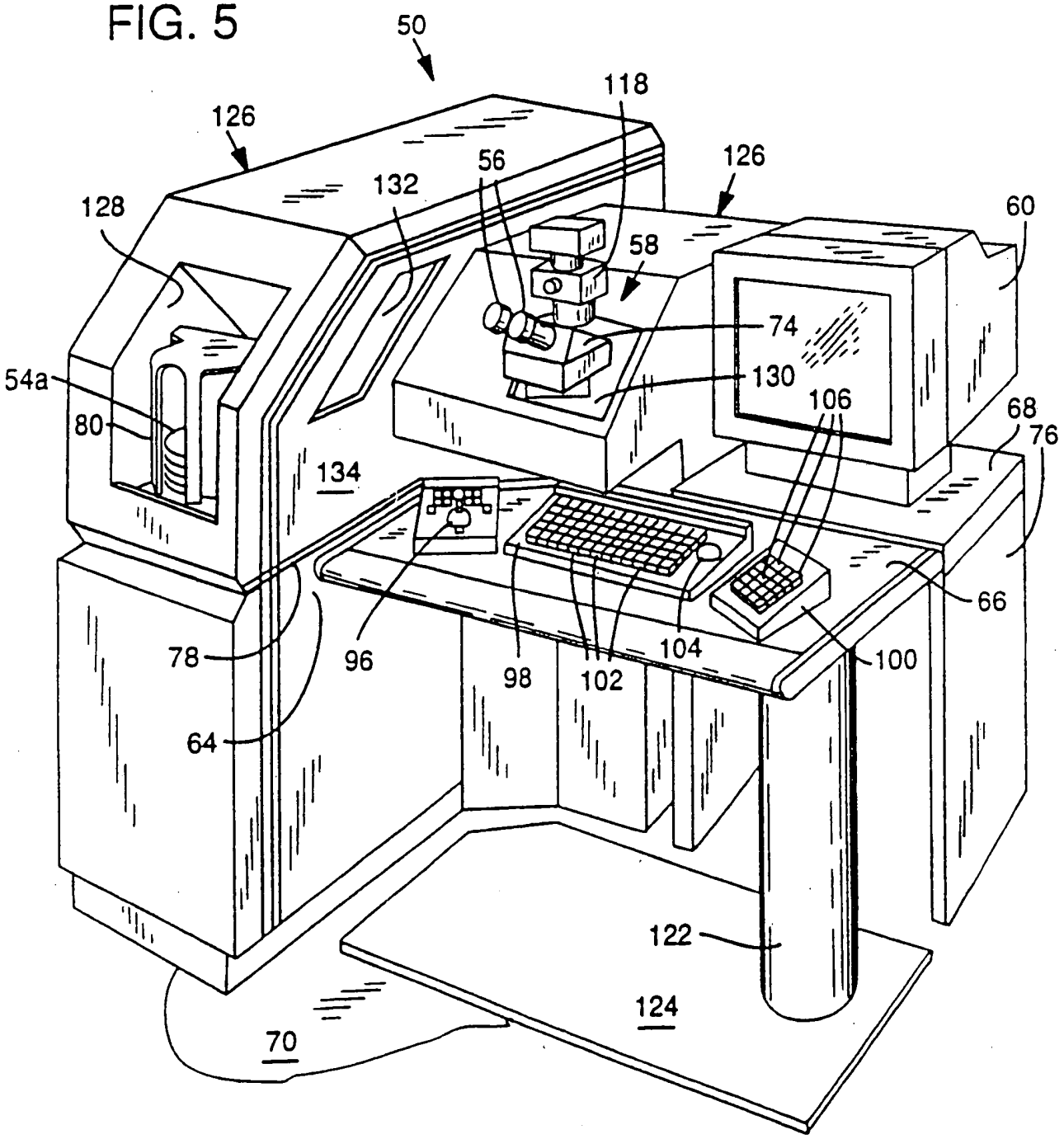
FIG. 5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INTERNATIONAL SEARCH REPORT

International Application No PCT/US90/06338

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC(5): G02B 21/26; G02 B 21/00; G01V 9/04
U.S. CL.: 350/529; 350/507; 250/221

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System [5]	Classification Symbols
U.S. CL.	350/507, 523, 528, 529, 530, 531, 532 250/221; 442.1; 356/244 414/225, 331, 416,749

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [6]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
A	US, A, 4,784,481 (WUERFEL) 15 NOVEMBER 1988, (See entire document).	1-20
Y	US, A, 4,818,169 (SCHRAM, DECEASED ET AL.) 04 April 1989, See figs. 1-2,4, columns 3-6,8 and 11-12.	1-7,13 AND 17-20
Y	PLO 52,586, "MICROVISION 360", Optical Specialites Inc., pages 1-2, 1988.	1-20
Y	US, A, 4,695,137 (JORGENS ET AL.) 22 September 1987, See fig. 1, column 2 (lines 8-24).	1-7,13 AND 17-20
A	Reference KLA-2600 Review Station, "Product Description", KLA Instruments Corporation pages 1-4, 09 December 1988.	1-20
A	Information Bulletin, 517 Scanning Stage System, E. LEITZ, INC. pages 1-7, 01 January 1985. (See entire document).	1-20
A	"Nikon Optistation Model 2 & 2A Wafer Inspection System", Nikon Optistation, pages 1-6, October 1984.	1-20

* Special categories of cited documents: [15]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search [1]	Date of Mailing of this International Search Report [1]
12 DECEMBER 1990	11 FEB 1991
International Searching Authority [1]	Signature of Authorized Officer [19]
ISA/US	BRUCE Y. ARNOLD